ABSTRACT

The Efficiency of Dust Reprocessing of UV into FIR in a Sample of 23 IR-Luminous Galaxies as Observed with the Kuiper Airborne Observatory

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Recent results from a KAO survey of fine-structure lines: [CII] 158 urn, [01] 63 urn, [Sill] 35 urn, [Sill] 19,33 urn, and [0111] 52, 88 urn, seen in the central regions of 23 infrared-luminous galaxies allow us to model the gas and dust properties of the neutral and ionized ISM. The galaxies span a wide range of morphologies (irregular to grand design), have varying metalicities, and include mergers, AGNs, and many starburst systems.

Electrons, photo-ejected from dust grains heat the neutral atomic gas in these nuclear regions. The efficiency of this process depends on the UV illumination, the gas density and dust grain properties. The warm atomic gas cools primarily through FIR fine structure transition of oxygen and carbon. We interpret the [CII] and [01] fluxes, along with measurements of the FIR continuum fluxes, in the context of photodissociation region models (Tielens & Hollenbach 1985; Wolf ire et al. 1990) and obtain estimates of the typical interstellar UV field incident on the line emitting regions(10A2 -1 0^3 times the Milky Way interstellar radiation field) and the total mass (1 0^7 - 10A8 MO,), density ($10^{A}3$ - $10^{A}4$ cm^{A}-3), and temperature (100 -200 K) of the warm atomic gas. We use the ionized fine structure transions of nitrogen and oxygen to probe the nuclear HII regions. The [0111] (52/88) and [Sill] (33/1 9) line flux ratios constrain the electron densities and pressures within the ionized regions. The [0111] and [Sill] lines also provide estimates of the effective temperature of the ionizing stars and elemental abundances. Our measurements imply gas pressures ofnT-10% cm^{A}-3 K and a typical cutoff to the upper mass limit of the IMF of about 20 MO.

The observations were made with the facility Cooled Grating Spectrometer onboard the KAO at a typical resolution of 80-170 km S^{A}-I and with a 35-42" beam.